WHAT IS CLAIMED IS:

1. A method for stir-friction welding a planar workpiece, using a rotating pin tool including a pin defining a diameter at a particular location along its length, said pin tool further including a shoulder at said location, said shoulder having a larger diameter than said pin, said method comprising the steps of:

rotating said tool;

applying force to said pin tool, with said pin tool plunged into one side of said workpiece, and with said shoulder essentially coincident with the surface of said one side of said workpiece, so that the rotating pin creates a friction-stirred region;

moving said workpiece and said rotating tool laterally relative to each other, so that said friction-stirred region progresses along said workpiece;

during said moving step, generating a signal representative of the force applied to said pin tool;

generating a reference signal representative of that force which is sufficient to maintain said shoulder against said one surface of said workpiece;

comparing said signal representative of the force applied to said pin tool with said reference signal, for generating an error signal representative of the difference between said force applied to said pin tool and said reference signal; and

using said error signal to control said step of applying force in a manner tending to maintain said shoulder in contact with said one surface of said workpiece, whereby said pin maintains substantially constant plunge depth.

2. A method according to claim 1, wherein said step of applying force includes the steps of:

coupling a lead screw to said pin tool and to a fixed reference point, whereby rotation of said lead screw applies pressure to said pin tool;

coupling the shaft of a force motor to said lead screw, for rotating said lead screw in response to rotation of said force motor,

whereby the force applied to said pin tool is responsive to the rotational position of said shaft of said force motor; and

rotating the shaft of said force motor in response to at least the magnitude of said error signal.

3. A method according to claim 2, wherein said step of rotating said shaft of said force motor includes the step of rotating said shaft of said force motor in different directions in response to the variation of said error signal relative to a particular value of said error signal.

4. A method according to claim 3, wherein said particular value of said error signal is zero.

5. A method according to claim 1, further comprising the step of limiting the magnitude of said error signal.

6. A method according to claim 1, further comprising the initial steps of:

positioning the tip of said pin tool adjacent said one surface of said workpiece;

generating a signal representing the plunge of said pin tool relative to said one surface of said workpiece;

generating a monotonically changing signal which represents a profile of the desired depth of plunge as a function of time;

generating a difference signal representing the difference between the actual plunge of said pin tool and the desired depth of plunge;

rotating said pin tool; and

controlling said force in response to said difference signal in such a manner that said force increases when said actual plunge is less than the desired plunge, and decreases when said actual plunge is more than said desired plunge.

7. A method according to claim 6, wherein the magnitude of said force is limited to a maximum value during said plunge.

8. A method according to claim 6, wherein said step of moving said workpiece and said rotating tool laterally relative to each other begins when said actual plunge equals said desired plunge.